

COLORADO DEPARTMENT OF TRANSPORTATION STAFF BRIDGE BRIDGE DETAIL MANUAL	Chapter: 1 Effective: June 15, 2012 Supersedes: September 9, 1999
GENERAL INSTRUCTIONS	

1.1 OVERVIEW OF THE DESIGN AND CONSTRUCTION PROCESS

The scope of engineering work from the design stage through the actual construction may be divided into six parts. A general knowledge of these parts in the design and construction of a structure is essential for the detailer to prepare a high quality set of plans. The parts are as follows:

I. Preliminary Design

In this part of the plan development, a structure type will be selected. Two or more alternate structure types will generally be considered at each site. Economy is usually the best substantiation for the final type selection. However, many other items shall be considered, such as:

- Appearance
- Maintenance costs
- Construction details
- Traffic convenience during construction
- Time for construction
- Similarity to adjacent structures
- Availability of materials
- Features crossed
- Span lengths
- Vertical clearance

The decisions made at this stage are very important, and time should be taken as necessary to assure a good start with valid criteria because the rest of the structure plans will be built around this information. Typically a General Layout sheet and Typical Sections are developed for this design phase.

II. Final Design

This stage includes a detailed stress analysis and preparation of drawings and sketches necessary to illustrate to the detailer the general arrangement of the structure, member sizes, and any other information necessary to clearly interpret the designer's ideas.

III. Detailing

This consists of preparing drawings from the designer's notes. The drawings must be clear enough for suppliers to prepare the necessary fabrication drawings and support any quantity calculations. As part of the detailing process, quantities shall be calculated and results used for preparing the summary of quantities table.

IV. Checking

The design check and quantity calculations shall be made, using the detail drawings.

June 15, 2012	Chapter No. 1	Page 2 of 12
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V. Fabrication

This includes cutting and bending of reinforcing steel, the building of the structural steel components, and the casting of precast-prestressed components.

VI. Construction

This consists of the actual building of the structure from the drawings. This phase of the work can be expedited by conscientious work during plan preparation.

1.2 GENERAL STEPS OF DETAILING PROCEDURES

When the detailer has received the design data for the preparation of the detailed drawings, the work may be divided into the following steps:

- Step 1 Design Study: The detailer shall carefully study the design notes and material provided by the designer. It is important that the detailer understand the Engineer's design, as well as the probable step-by-step construction of the structure. The detailer is expected to carry out all instructions given in the design notes; nevertheless, any points that the detailer considers worthy of discussion must be brought to the attention of the designer.
- Step 2 Bridge Geometry: The person preparing the Bridge Geometry input shall study the layout of the structure, and while coding in the geometry input shall refer to the Bridge Geometry User's Manual provided by the Staff Bridge Branch.
- Step 3 Planning the Drawings: The detailer shall plan the drawings, determining what details and information are to be placed upon each sheet, the scales to be used and the number of sheets required.
- Step 4 Preparation of the Drawings: This consists of the actual drafting procedure. The detailer and/or designer will prepare some sketches and computations as necessary to place accurate information on the drawings.
- Step 5 Checking: Upon completion of the drawing set, copies are given to the designer, the design checker and the detail checker, along with all pertinent data necessary to perform a comprehensive check. All dimensions, stations, elevations, and details shall be checked for accuracy and consistency. A consistent method of markups shall be used. In a commonly used system, the checkers indicate possible corrections or additions that may be needed on the drawings in red. Correct information is highlighted in yellow. Marked up drawings should be initialed and dated. When the checking has been completed, the check prints shall be returned to the designer for the use of the detailer.
- Step 6 Making Corrections: After verifying the redlined corrections indicated on the check prints, the detailer shall then make the changes. As the changes are being made, they shall be marked in yellow highlighter prior to returning to the checker. Alternately, the check prints may be marked "changes made" with initials and date.

1.3 CORRECTIONS OF DESIGNER'S DETAIL NOTES

In the course of the detailing procedure, it may become necessary to make revisions to the design notes. It shall be the designer's responsibility to keep the design notes current. Computer aided drafting has increased the ability to speed up the detailing process, however the design should be as complete as possible before the detailer starts working on the project to minimize changes.

1.4 STRUCTURE NUMBER

It is the responsibility of the designer to have a structure number assigned before design commences, however, the following information will be of interest to the detailer and checker alike:

The Bridge Management Unit has the responsibility of assigning structure numbers. The Structure Number Coding Guide shall be used to determine the structure number. Refer to the BRIAR Manual for additional details for structure numbers. The following information is necessary before they can assign a number to a given structure:

- (a) Geographical Location
 - 1. Highway Number (State) and Mile Post (if Mile Post is not known, Latitude and Longitude information may be substituted)
 - 2. Feature Intersected (stream, river, highway, etc.)
- (b) Project Number
- (c) Existing structure number, if applicable
- (d) Structure Information
 - 1. Type
 - 2. Material
 - 3. Bridge Typical Section

Structures that carry traffic are placed into two categories:

- Major structures are those with clear span lengths greater than 20 feet.
- Minor structures with clear span lengths 4 to 20 feet.

Lengths are measured along the centerline of the roadway. The Bridge Management Unit will make any decisions pertaining to structure numbers. The Bridge Management Unit will maintain records on all structures. Twin bridges with closed median generally will not have two separate numbers.

Major Structure Numbers:

Figure 1.4-1 shows a typical Major structure number. The first letter and the following two numbers describe the grid location of the structure as shown in Figure 1.4-2, and the last letter or letters are unique to the structure within the grid boundaries. All letters shall be uppercase.

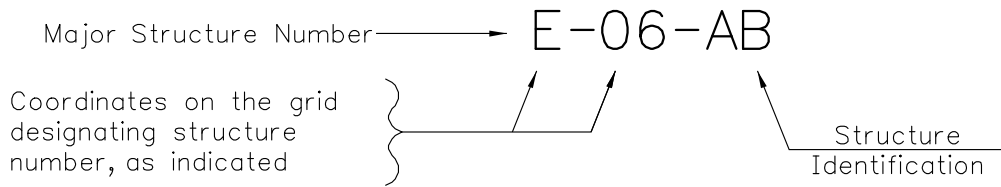


Fig. 1.4-1 Major Structure Designations

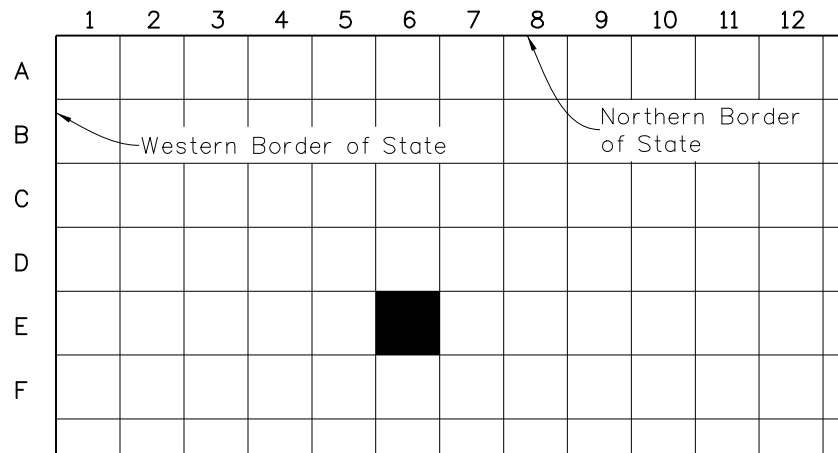
Generating Structure Numbers

Fig. 1.4-2 Structure Designation

Minor Structure Numbers:

Structures are identified by a 12 or 14 character code as follows:

1. First 4 digits = highway and Highway section
2. Next 6 digits = mile point with an assumed decimal point after character 3
3. Next character =lanes carried
B= Both, N= North, E= East, W= West S=South
(A single direction would indicate an open median exists between parallel structures).
4. 12th character indicates the structure high side (inlet) looking up mile point. R = Right; L = Left
5. For new structures "-A" (for first built) would be added to the above name.

EXAMPLE: 085L306950BL-A

This structure carries US85 at milepost 306.950. It carries traffic in both directions, and the water flows from Left to Right as one looks up mile point. It was rebuilt fairly recently.

Lists of structure numbers (Major structures, Minor structures, Walls, Span Wires) are available from the Bridge Management Group as well as the Field Log of Structures.

New structure numbers will be assigned to structures that are replacing existing ones. Because of historical tracking, the old structure numbers will not be reused. The lengths to be used in defining a major or minor structure for various types of structures are as follows:

(a) Bridges

The distance measured along the centerline of roadway between front faces of abutments. Refer to Figure 1.4-3.

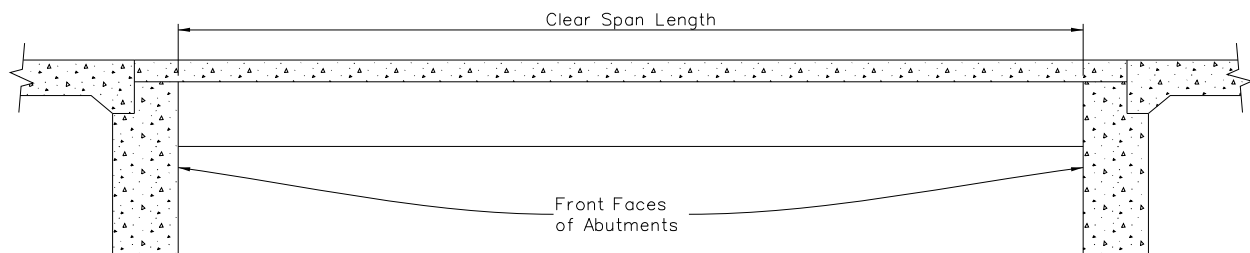


Fig. 1.4-3 Length of Bridges

(b) Arches

The distance measured along the centerline of roadway between the spring lines of arches. Refer to Figure 1.4-4.

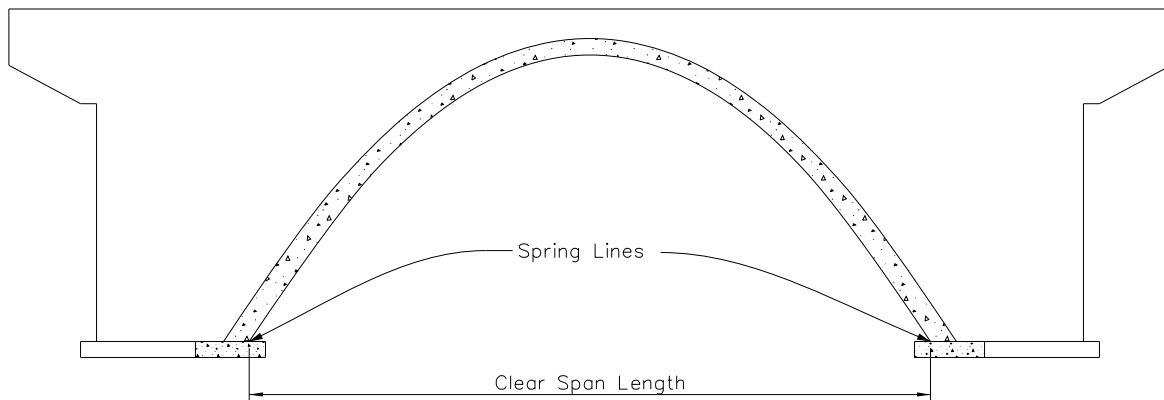


Fig. 1.4-4 Length of Arches

(c) Multiple Boxes

The distance measured along the centerline of roadway between extreme ends of openings. Refer to Figure 1.4-5.

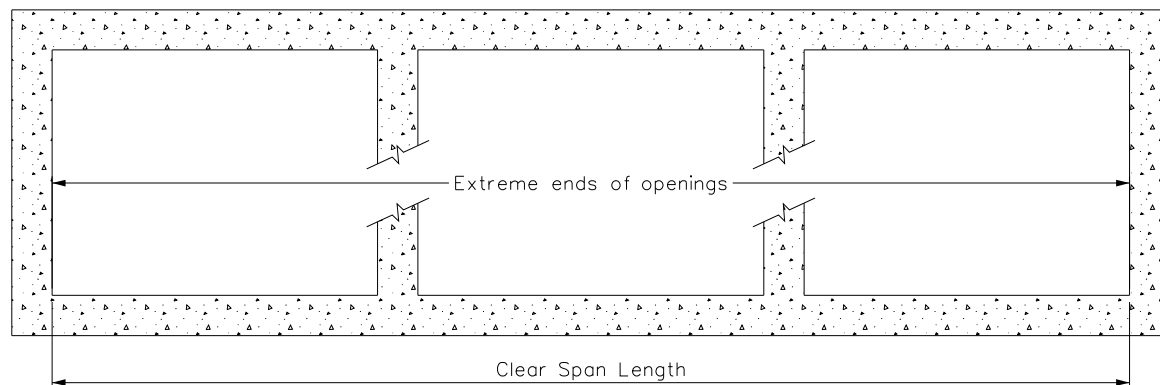


Fig. 1.4-5 Length of Multiple Concrete Boxes

(d) Multiple Pipe Culverts Classified as NBI bridges:

The 4 main requirements are:

- 1) Installation must carry vehicular traffic,
- 2) Must be open to the general public,
- 3) Must be maintained or owned by a public entity, and
- 4) The distance measured parallel to the centerline of roadway from the outside of the first pipe to the outside of the last pipe, must be over 20 feet in length. The distance between pipes must be less than or equal to the radius of the smallest pipe in the group. For clarification in questionable cases, see the Bridge Asset Management unit.

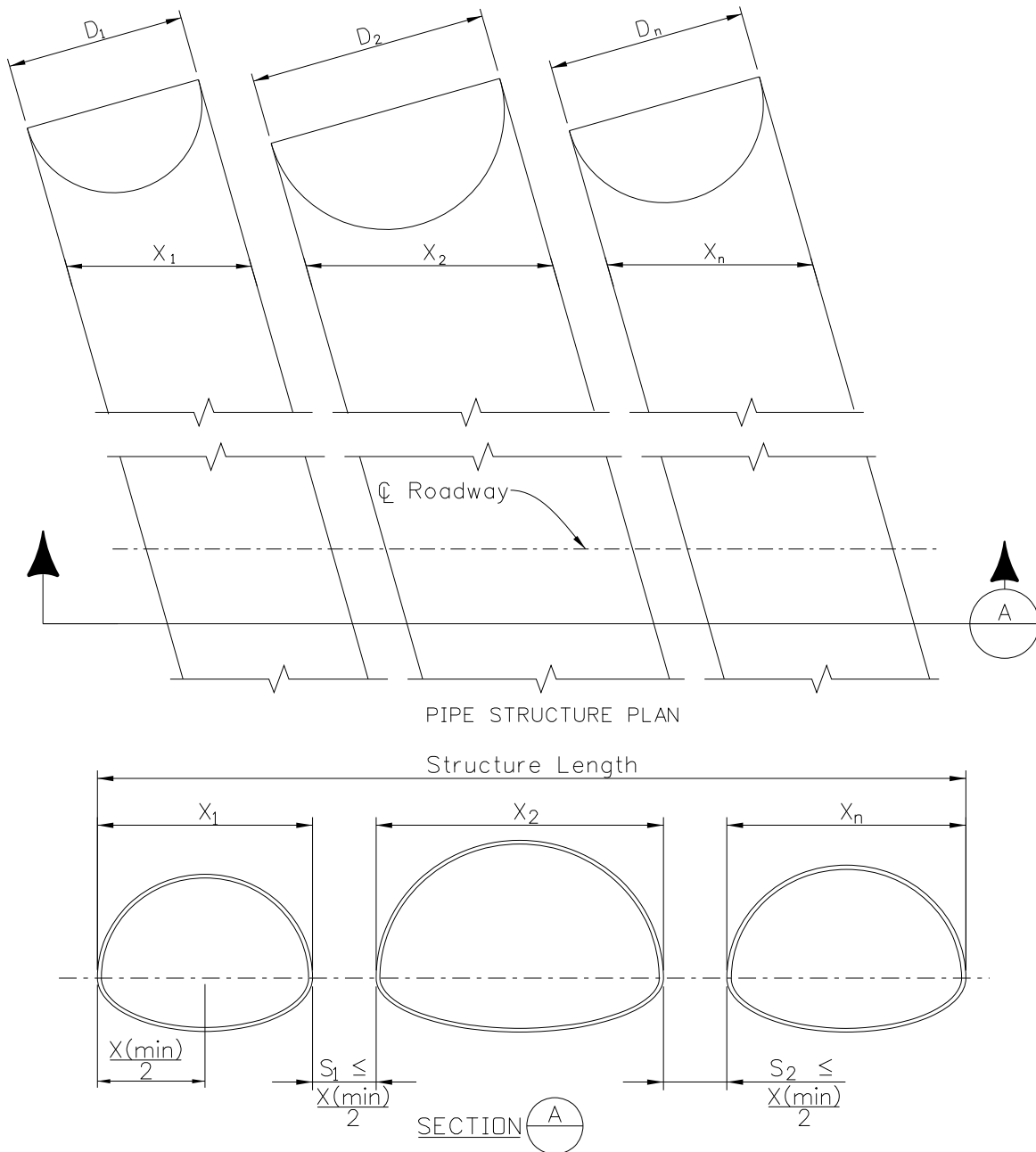


Fig. 1.4-6 Length of Multiple-Pipe Culverts (Classified as a structure).

1.5 WALL STRUCTURE NUMBER

The Bridge Management Unit shall assign Wall Structure Numbers to both sound walls and structural retaining walls. The number shall start with WALL, then a grid designation, followed by a unique letter or letters. Example: WALL-E-16-AX.

To be designated as a Structural Retaining Wall and therefore be assigned a structure number, a wall must meet one of the following criteria:

- (a) The length of the wall must be 100 feet or greater, and any portion of the wall height must be 5 feet or greater as measured from top of footing to top of wall. Walls over 15 feet in height may be given a structure number regardless of length.
- (b) The wall has a rail-anchoring slab.

1.6 ACCURACY OF DIMENSIONS AND ELEVATIONS

The degree of accuracy used on the drawings shall be as follows:

- (a) Structural dimensions to the nearest 1/8 inch with the following exceptions:
 - 1. Bearing device dimensions on abutments and piers to the nearest .001 foot.
 - 2. Top of concrete of the bearing seat to the nearest 1/16 inch.
 - 3. Stations to the nearest .01 foot.
 - 4. Foundation, Construction, Girder Layout dimensions (dimensions along tangents, etc.) to the nearest .01 foot.
 - 5. Dead load deflections to the nearest .0001 foot.
 - 6. Tip elevations of caissons, and estimated pile tips, shall be given to the nearest foot.
 - 7. Elevations for bottoms of footings shall be rounded to the nearest .01 foot.
- (b) Skew angles and bearings shall be given to the nearest second. Example: 69°38'13".
- (c) Other angles shall be given so that dependent dimensions meet the above criteria.

1.7 RESPONSIBILITY FOR PLAN DRAWINGS

Drawings shall be prepared and checked in the design unit. The graphic presentation of the information on these drawings shall be the responsibility of the individual preparing the drawings. Any differences of opinion for graphical presentation between designer and detailer not clearly delineated in the Detailing Manual shall be brought to the attention of the unit leader for clarification.

1.8 CHECKING PLAN DRAWINGS

The designer, detailer, and detail checker are each responsible for contributing to an acceptable, error free set of contract plan drawings. A conscientious cooperation among all three parties is required to accomplish this.

It is important to correct all errors in the plan drawings before a project is advertised. This will avoid contract revisions, Contractor claims, added construction costs, and additional time charged to projects to address construction problems caused by plan errors.

Because of the importance of checking the plans, adequate time shall be allowed for this process, even in high priority rush jobs.

The following outlines the various responsibilities of the designer, detailer, and detail checker during the plan checking process:

- (a) The designer shall check the plans to assure that the design was correctly conveyed in the plans and is constructible.
- (b) The detailer shall check every detail in the plans for neatness, correctness, completeness, constructability and clarity.
- (c) The designer and detail checker shall back check the plans, after the detailer has made the revisions to the plans to assure all changes have been made.

Additional information and instructions for checking will be discussed in subsequent chapters of this manual.

1.9 BORDER INFORMATION

- (a) TITLE BLOCK

The sheet title shall be a description of the details or information shown on the drawing. All letters in the sheet title shall be capitals.

The structure number, first initial and the last name of the Designer and Detailer, project number, sub-account number, Subset initial (e.g., "B", "W" etc.) & number, and total number of subset drawings shall be filled in on each sheet. The total number of sheets in the subset can be placed either in the CAD drawing or could be placed in the Acrobat PDF version of the file that is submitted with the final detail letter. The full version of Adobe Acrobat is required for this capability. The Sheet Number should be left blank so it can be filled in later by the project manager.

The original detailer should make corrections if possible. Do not change detailer name or initials if you make changes to someone else's drawing. This would be changed only if another detailer makes major revisions to a sheet. Only one detailer should be listed.

GENERAL LAYOUT				Project No./Code	
				FBR 0703-357	
Designer: M. Yip		Structure Numbers	F-14-AZ		17671
Detailer: R. Olmos					
Sheet Subset: Bridge		Subset Sheets: B03 of 23		Sheet Number	
12	13		14	15	16

Fig. 1.9-1 Sample Title Block

(b) REGION INFORMATION

Provide the Resident Engineer information for the overall project. If there is no assigned Resident Engineer such as with repair plans, provide the Unit Leader information for the project or repair. The As-Constructed information to the right of the resident engineer information is not filled out by Staff Bridge.


Colorado Department of Transportation		As Constructed
 401 A Avenue Limon, CO 80828 Phone: 719-775-8002 FAX: 719-775-8014 Region 1	TAM	No Revisions:
		Revised:
		Void:

Fig. 1.9-2 Sample Region Information

(c) SHEET REVISIONS

When changes are required after the project has been advertised, it may be necessary to revise the drawings. The modifications made on the drawings shall be flagged and noted in the revision block on the modified sheet.

The person initiating the revision shall give the date per Design Engineer, a brief notation indicating the nature of the revision, and the initiator's initials. If the initiator is the detailer correcting typos or measurement or quantity errors, the detailer's initials would be appropriate. If the revision involves engineering judgment, the Design engineer's initials would be appropriate.

At the left of the revision date are flagging symbols. The revision number such as R-1, R-2 used during the Ad period, or FR-1, FR-2 used during construction shall be placed into the symbol. This symbol, with the revision number, shall be placed near the location on the drawing where the particular revision occurs. A revision cloud may be used to clarify the portions of revisions as well.

When a new drawing is added, the date and the notation "New Sheet" shall be placed in the revision block. Any sheets that are revised or replaced after the award of a project are given an X after the Sheet Number in the Title Block area such as 128X. Subset sheets will not be given the "X" designation. Since the overall sheet numbering is usually known at that time, the detailer should place this number on the sheet. Any sheets that are added are given letter numbers such as 128A, 128B, etc.. The original total number of sheets is not revised even though the actual total may be increased. Additional information may be found in Section 121.2.3.2.1 of the Construction Manual.

Coordination of revision dates with other departments shall be made through the Unit Leader. Figure 1.9-3 shows typical revision notes.

	Sheet Revisions		
	Date:	Comments	Init.
(R-1)	6/3/03	Added expansion joint note	SLW
(FR-1)	6/30/03	Corrected Dimension	BAF

Fig. 1.9-3 Typical Revision Notes

(d) MISCELLANEOUS INFORMATION

The lower left hand corner of the border contains miscellaneous information on print date, file name, scale as well as the responsible unit information. The scale should be filled out as appropriate. When all details or sections on a drawing layout are at the same scale, the scale information block on the border should be filled in or edited with the correct scale. If varying scales are used on the drawing, the scale information block on the border should be filled out with VARIES, NOT TO SCALE, NTS, NONE or other appropriate description. If a design is done by a consultant, the consultant information can be placed in the lower box.

A time stamp is useful for keeping track of different versions of the hard copy drawings during the detailing process. The preferred placement is at the left side of the drawing, displayed vertically as shown.

potto 8:45:03 AM P:_Brid

Print Date: 6/15/2012
File Name: Fig_1_9-1,2,3,4,5.dgn
Horiz. Scale: Not to Scale Vert. Scale: As Noted
Staff Bridge Branch - Unit 0221 Unit Leader STW
(Consultant Information as applicable)

123

Fig. 1.9-4 Sample of Miscellaneous Information

(e) SHEET GRID

The sheet grid as depicted in Fig. 1.9-4 is optional at the discretion of the detailer and/or designer. If the grid is used, it shall be used on all sheets of the subset.

(f) INITIAL BLOCK

Give the initials of the person who performed each of these functions, along with the date on which these functions were completed. The Initial Block shall be completely filled out on each sheet.

Design			Detail			Quantities		
	INITIAL	DATE		INITIAL	DATE		INITIAL	DATE
Designed By	MCY	12/09	Detailed By	RD/CL	12/09	Quantities By	MCY	01/10
Checked By	GMT	01/10	Checked By	MCY	01/10	Checked By	CSL	01/10

Fig. 1.9-5 Sample of Initial Block

1.10 FILE NAMING CONVENTIONS

To assist the detailer and anyone else working on the drawings, a consistent file naming convention shall be used. The first two or, in rare cases, three characters in the filename should be the drawing number for the finished sheet in relation to the set, for example 01 for the first drawing, 02 for the second, etc. The rest of the filename should be a brief description of the drawing's contents. The file extension is typically a 3-letter code that is set by the software used to create the file. A complete filename looks something like this: "04GeneralLayout.xxx". In this case, "04" indicates that the file is the fourth file in the drawing set, it is the drawing titled General Layout. The xxx would be determined by the software used.

Abbreviations of common terms may be acceptable so long as the meaning is clear. Although brevity is important in the drawing file name, it is possible to be too brief. Every attempt should be made to keep drawing file names between 10 and 25 characters not including the extension in order to fit in the border.

1.11 DIRECTORY STRUCTURE

A comprehensive directory structure shall be maintained throughout the project. Simplicity is the key to being able to maintain and back up all of the appropriate information. An example would be:

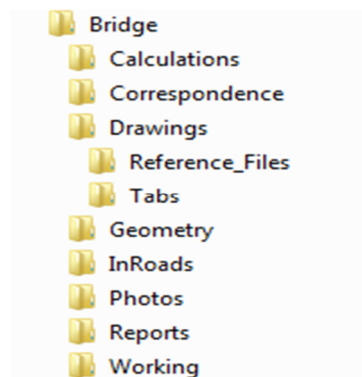


Fig. 1.11-1 Directory Structure

Responsibility for maintaining the drawing files and directory structure rests solely on the design team. All production files that are worked on by more than one person should be kept in a central location (such as a file server).

Duplication of files is highly discouraged. The detailer should not copy a file from one location to another for the sole purpose of making changes and then copy the modified file back to its original location. This practice creates unnecessary multiple copies and increases the risk of losing information. A notification system shall be used whose purpose is to notify each user when a requested file is in use by another user.

1.12 Structural Worksheets

Structural worksheets that are currently in use are available on the Bridge website. The intent of these worksheets is to provide a starting point for generally used items on projects. It is necessary to modify them as needed to

match project requirements. The website versions are the up-to-date versions and should be used on new projects. Any permanent corrections, changes or improvements to the worksheets should be coordinated with the Bridge Project Support Unit. The revision dates are included on the left hand side of the border. This information should be deleted after FIR level plans are produced.

Revision Dates (Preliminary Stage Only)							
3/99	4/99	11/99	5/00	4/02	6/04	2/06	3/07

Fig. 1.12-1 Sample of Worksheet Revisions

1.13 Structure Component Naming

To maintain the consistency between design drawings and information used in the inspection process and management of the finished structure, a similar naming convention for structural components should be used. This includes girder naming as well as inventory stationing conventions. Girders and columns are lettered from left to right (looking in the direction of increasing milepoint). Bays in between girders or columns are labeled similarly. Span number is included in the girder description to clarify its location on the bridge as shown in Fig. 1.13-1.

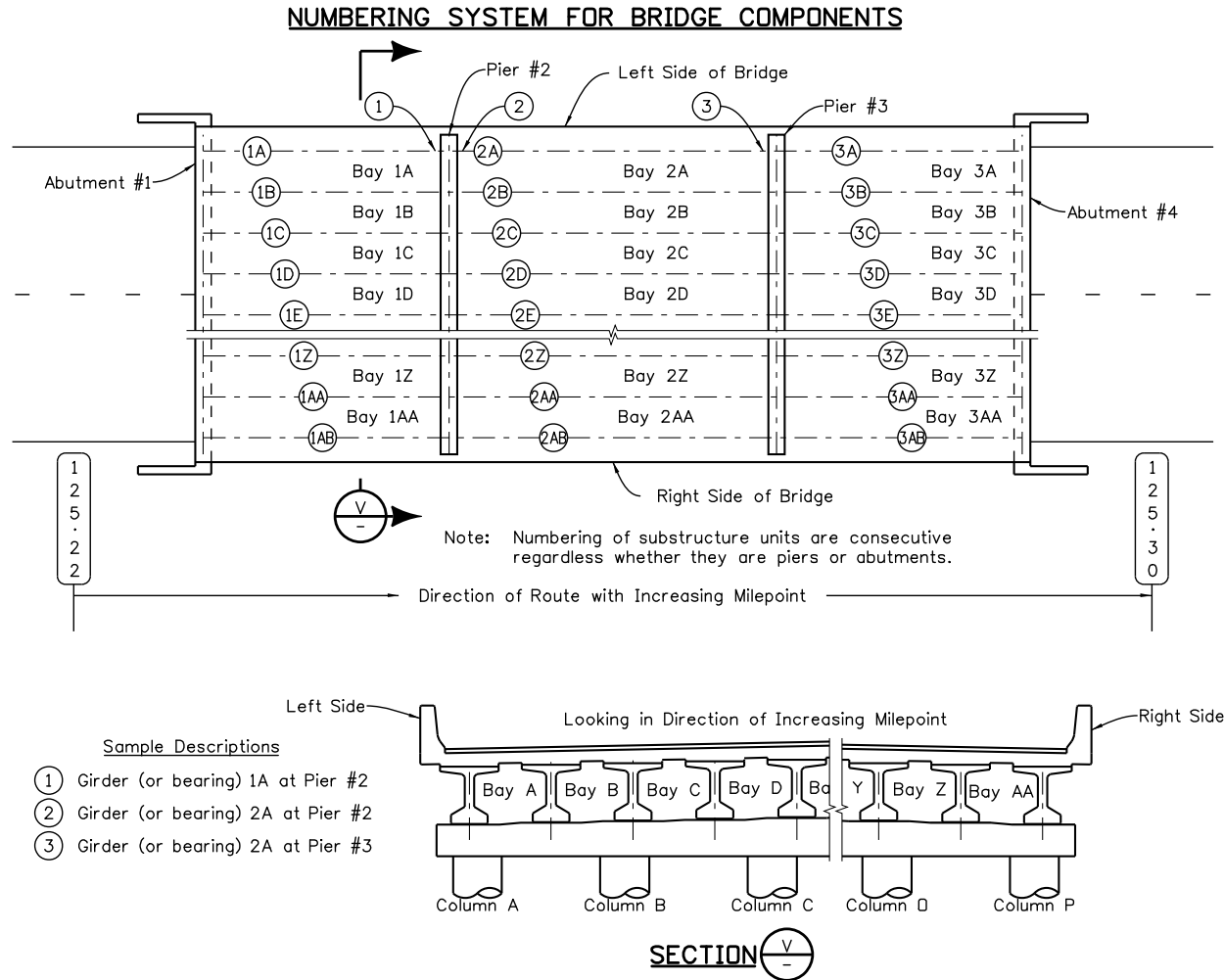


Fig. 1.13-1 Structure Component Naming Convention